

What Is Claimed Is:

1. A method of electrodeposition of a metal, the method comprising:
preparing an electroplating solution, the electroplating solution including a mixture of soluble metallic salts and organic additives dissolved in a non-aqueous non-aromatic organic solvent; and
electrodepositing the metal from the electroplating solution onto a conductive substrate under a cathodic current.
2. The method of claim 1, wherein the soluble metallic salts are a metal alkoxide.
3. The method of claim 2 wherein the metal alkoxide is selected from the group consisting of metal ethoxides, propoxides, isopropoxides, butoxides, corresponding halides, phosphates, and carbonates, and mixtures thereof.
4. The method of claim 1, wherein the metal is selected from the group consisting of aluminum, titanium, tantalum, zirconium, molybdenum, tungsten, niobium, osmium, hafnium, magnesium and alloys and combinations thereof.
5. The method of claim 1, wherein the non-aqueous non-aromatic organic solvent is a low molecular weight non-aromatic solvent.
6. The method of claim 1, wherein the non-aqueous non-aromatic organic solvent is an alcohol or an amine.
7. The method of claim 6, wherein the alcohol has more than one OH functional group.

8. The method of claim 1, wherein the non-aqueous non-aromatic organic solvent is selected from the group consisting of ethanol, propanol, isopropanol, butanol, 2-butanol and ethanolamine.
9. The method of claim 1, wherein a concentration of the soluble metallic salt in the electroplating solution is from 5% to 100% of a saturation concentration for the metallic salt in the non-aqueous non-aromatic organic solvent at an operational temperature for electrodeposition.
10. The method of claim 1, comprising adding a conductive additive to the electroplating solution to increase solvent conductivity.
11. The method of claim 10, wherein the conductive additive is a low molecular weight organic solid.
12. The method of claim 10, wherein the conductive additive is oxalic acid, citric acid, ammonium citrate or a chloride, a pentachloride, a tetrachloride of the metal, or an organic or inorganic compound soluble in the electroplating solution.
13. The method of claim 1, comprising continuously filtering the electroplating solution over molecular sieves and maintaining an inert atmosphere over the electroplating solution during at least electrodeposition.
14. The method of claim 13, wherein the inert atmosphere maintains a substantially oxygen-free and moisture-free atmosphere in contact with the electroplating solution.
15. The method of claim 1, comprising splitting the electroplating solution into a separate catholyte compartment and a separate anolyte compartment, the catholyte compartment and the anolyte compartment separated by a membrane.

16. The method of claim 1, comprising agitating the electroplating solution or agitating a part being electroplated.
17. The method of claim 1, comprising preparing a surface of the conductive substrate for electrodeposition by grit blasting the surface, masking the surface, cleaning with an alkali or acid cleaning solution and removing the cleaning solution by an alcohol dip or spray.
18. An electroplating solution, comprising:
a non-aqueous non-aromatic organic solvent; and
a mixture including soluble metallic salts and organic additives, the mixture dissolved in the non-aqueous non-aromatic organic solvent.
19. The electroplating solution of claim 18, wherein the soluble metallic salts includes aluminum salts that allow the electrodeposition of aluminum.
20. The electroplating solution of claim 18, wherein the soluble metallic salts includes titanium salts that allow the electrodeposition of titanium.
21. The electroplating solution of claim 18, wherein the soluble metallic salts includes tantalum salts that allow the electrodeposition of tantalum.
22. The electroplating solution of claim 18, wherein the soluble metallic salts includes zirconium salts that allow the electrodeposition of zirconium.
23. The electroplating solution of claim 18, wherein the soluble metallic salts includes at least one refractory metal salt that allows the electrodeposition of a refractory metal.
24. The electroplating solution of claim 23, wherein the refractory metal is molybdenum, tungsten, niobium, osmium, hafnium, alloys or combinations thereof.

25. The electroplating solution of claim 18, wherein the soluble metallic salts are a metal alkoxide.

26. The electroplating solution of claim 18, wherein the non-aqueous non-aromatic organic solvent is a low molecular weight non-aromatic solvent.

27. An electroplating system, comprising:
a plating chamber containing an electroplating solution;
an entry point to the electroplating system; and
a transporting system to convey a part to be electroplated from the entry point to the plating chamber,
wherein the electroplating solution includes a non-aqueous non-aromatic organic solvent and a mixture including soluble metallic salts and organic additives, the mixture dissolved in the non-aqueous non-aromatic organic solvent.

28. The electroplating system of claim 27, wherein the plating chamber includes a single electroplating compartment or a split electroplating compartment for an anolyte and a catholyte.

29. The electroplating system of claim 27, wherein the plating chamber includes a split electroplating compartment having two anodes arranged essentially opposing each other with the catholyte in between, each anode separated from the catholyte by a membrane.

30. The electroplating system of claim 27, comprising an external chamber housing molecular sieves and wherein the electroplating solution is continuously agitated by circulation through the external chamber.

31. The electroplating system of claim 27, comprising a source of inert gas and an inert atmosphere maintained within at least the plating chamber by gas regulation of the source of inert gas.

32. The electroplating system of claim 31, wherein the inert atmosphere is maintained at a positive pressure.

33. The electroplating solution of claim 27, wherein the soluble metallic salts are a metal alkoxide.

34. The electroplating solution of claim 27, wherein the non-aqueous non-aromatic organic solvent is a low molecular weight non-aromatic solvent.